Claims

1. A multi-stage optical amplifier (1) to amplify a transmission signal including a signal wavelength (λ_s) comprising
   - a first amplifying stage (2) including a rare-earth doped optical active fiber (5);
   - a second amplifying stage (3) connected to said first amplifying stage (2), said second amplifying stage (3) including a tellurite-based active fiber (10) doped with a rare earth element; and
   - a third amplifying stage (4) connected with said second amplifying stage (3), said third amplifying stage (4) including a silica-based fiber (16; 30).
2. A multi-stage optical amplifier (1) according to claim 1, wherein said first (2), second (3) and third amplifying stage (4) are connected in series.
3. A multi-stage optical amplifier (1) according to claim 1 or 2, wherein said signal wavelength (λ_s) is in the range of 1530-1625 nm.
4. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said input signal carries a given number of optical channels having wavelengths (λ_{S1}, ..., λ_{Sn}) comprised between about 1530 nm and 1625 nm.
5. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said rare earth doped active fiber (5) of said first amplifying stage (2) is an erbium doped active fiber.
6. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said rare-earth doped active fiber (5) of said first amplifying stage (2) is a silica-based active fiber.
7. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said first amplifying stage (2) comprises a first pumping source (7) to supply a first pumping radiation to said rare-earth doped active fiber (5) at a first pump wavelength (λ_{p1}).

8. A multi-stage optical amplifier (1) according to claim 7, wherein said first pumping radiation and said transmission signal are co-propagating within said rare-earth doped active fiber (5).

9. A multi-stage optical amplifier (1) according to claim 7 or 8, wherein said first pump wavelength (λ_{p1}) is substantially equal to 980 nm.

10. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein an optical isolator (15) is located between said first (2) and said second amplifying stage (3).

11. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein an optical isolator (9) is located at the input of said first amplifying stage (2).

12. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said tellurite-based active fiber (10) doped with a rare-earth element of said second amplifying stage (3) is a tellurite-based erbium doped active fiber.

13. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said second amplifying stage (3) comprises a second (11) and a third pumping source (12) for supplying second and third pumping radiation at second and third pump wavelength (λ_{p2}, λ_{p3}), respectively, to said tellurite-based active fiber (10) doped with a rare-earth element.

14. A multi-stage optical amplifier (1) according to claim 13, wherein said second pumping radiation and an optical signal outputted by said first amplifying stage (2) are co-propagating, and said third pumping radiation and said optical signal outputted by said first amplifying stage (2) are counter-propagating within said tellurite-based active fiber (10) doped with a rare-earth element.

15. A multi-stage optical amplifier (1) according to claim 13 or claim 14, wherein said second and third pump wavelength (λ_{p2}, λ_{p3}) are both substantially equal to 1480 nm.

16. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said silica-based fiber (16) of said third amplifying stage (4) is a rare-earth doped active fiber.

17. A multi-stage optical amplifier (1) according to claim 16, wherein said silica-based fiber (16) of said third amplifying stage (4) is an erbium-doped active fiber.

18. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein said third amplifying stage (4) comprises a fourth (17) and a fifth pumping source (22) for supplying a forth and fifth pumping radiation at a fourth and fifth wavelength (λ_{p4}, λ_{p5}), respectively, to said silica-based fiber (16).

19. A multi-stage optical amplifier (1) according to claim 18, wherein said fourth pumping radiation and an optical signal outputted by said second amplifying stage (3) are co-propagating, and said fifth pumping radiation and said optical signal outputted by said second amplifying stage (3) are counter-propagating, within said silica-based fiber (16).

20. A multi-stage optical amplifier (1) according to claim 18 or claim 19, wherein said fourth and fifth pump wavelength (λ_{p4}, λ_{p5}) are both substantially equal to 1480 nm.

21. A multi-stage optical amplifier according to any one of claims 1-15, wherein said silica-based fiber (30) is a Raman-active fiber.

22. A multi-stage optical amplifier according to claim 21, wherein said silica-based fiber (16) is a dispersion compensating fiber.

23. A multi-stage optical amplifier according to claim 21 or claim 22, wherein said third amplifying stage (4) comprises a pumping source (31) for supplying a pumping radiation at a pump wavelength (λ_{p6}) to said Raman-active fiber (30).

24. A multi-stage optical amplifier according to claim 23, wherein said pumping radiation and an optical signal outputted by said second amplifying stage (3) are counter-propagating, within said Raman-active fiber (30).

25. A multi-stage optical amplifier (1) according to claim 23 or claim 24, wherein said pump wavelength (λ_{p6}) is substantially included in the range from 1460 to 1500 nm.

26. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein a gain equalizer (25) is interposed between said second (3) and third amplifying stage (4).

27. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein an optical isolator (19) is interposed between said second (3) and third amplifying stage (4).

28. A multi-stage optical amplifier (1) according to any one of the preceding claims, wherein an optical isolator (23) is inserted at the output of said third amplifying stage (4).